

AMENDMENTS TO THE SPECIFICATION:

Page 1, please add the following new paragraphs before paragraph [0001]:

[0000.2] CROSS-REFERENCE TO RELATED APPLICATIONS

[0000.4] This application is a 35 USC 371 application of PCT/DE 03/01934
filed on June 11, 2003.

[0000.6] BACKGROUND OF THE INVENTION

[0000.8] Field of the Invention

Please replace paragraph [0001] with the following amended paragraph:

[0001] The present invention relates to a device for determining the state of a particle filter ~~with the characteristics mentioned in the preamble to claim 1~~ and a method for determining the state of a particle filter ~~with the characteristics mentioned in the preamble to claim 9~~.

Please replace paragraph [0004] with the following amended paragraph:

[0004] Particle filters ~~[(DPF)]~~ in motor vehicles ~~[(KFZ)]~~ make an important contribution to compliance with stricter exhaust limit values. These filters are highly efficient at removing particles from the exhaust flow.

Please replace paragraph [0005] with the following amended paragraph:

[0005] Particles, and diesel particles in particular, are partially made up of agglomerations of primary particles composed of hydrocarbon compounds. They are also partly composed of pure carbon. They result from incomplete combustion in the combustion chamber and range from **about** 50 to 200 nm in size. They are usually geometrically irregular in shape. The particle quantity and composition depend heavily on engine load conditions, the injection system, and the chemical composition of the fuel.

Page 2, please replace paragraph [0006] with the following amended paragraph:

[0006] Deposited solids reduce the permeability of the filter, as a result of which the exhaust backpressure increases, which in turn leads to engine output losses and to increased fuel consumption. For this reason, the filter is regenerated after it reaches a certain saturation level. In this connection, a temperature increase serves to convert the majority of the oxidizable particulate load into gaseous carbon dioxide [[CO₂]] and carbon monoxide [[CO]] and consequently removes it from the filter. After successful regeneration, the exhaust backpressure once again assumes a significantly lower initial value.

Please replace paragraph [0008] with the following amended paragraph:

[0008] One known method is to use a differential pressure sensor, which detects the pressure decrease [[via]] across the filter body. The differential pressure and therefore the pressure decrease, however, are determined by both the filter permeability and the volumetric flow at the filter. The volumetric flow in turn depends on the operating conditions of the engine and the exhaust temperature at the filter body, thus resulting in a large degree of cross sensitivity to various influence parameters. With the usual use of ceramic wall flow filters with parallel channels, the flow resistance is the result of the parallel connection of all of the filter channels and the surface elements contained in them. If a sufficiently large number of these surface elements is cleaned by the regeneration, then the flow resistance decreases so far that a control unit, which monitors the regeneration, could erroneously conclude that the regeneration is complete, and therefore terminate the temperature-increase measures and thus the particulate oxidation. This can result in undesirable accumulations of combustible material in some regions of the [[DPF]] filter.

Page 3, please replace paragraph [0009] with the following amended paragraph:

[0009] Another possibility for determining the load state of the [[DPF]] **filter** is to use characteristic field data to calculate the particulate mass emitted by the motor through chronological integration over the operating points through which the engine has passed. This method has a large degree of uncertainty, particularly in dynamic driving conditions, due to the risk of an error-induced change in particulate emissions. It can be taken into account for plausibility testing of other measurement methods.

Please replace paragraph [0010] with the following amended paragraph:

[0010] In order to avoid this uncertainty in the calculated particulate emission, another possibility is to measure the particulate concentration upstream of the [[DPF]] **filter** with the aid of a sensor.

Please replace paragraph [0012] with the following amended paragraph:

[0012] As mentioned above, the sensor is only an aid for estimating the fill state of the [[DPF]] **filter** through integration of the particulate quantity produced by the motor. The regeneration method itself introduces an uncertainty into the determination of the fill state. Since the increase in temperature represents a significant intervention into the motor management, this measure should be executed as seldom as possible and for as short a time as possible. As a result of this, in actual use, the problem of the [[DPF]] **filter** not being completely regenerated can arise and regions of the filter can remain partially loaded with residue. If additional particulate matter continues to accumulate during the subsequent loading phase, then a critical load concentration can occur in certain areas, which leads to an overheating in these areas in subsequent regeneration cycles. This can result in irreversible damage to filter structures.

Page 4, please replace paragraph [0013] with the following amended paragraph:

[0013] ~~Advantages of the Invention~~

SUMMARY AND ADVANTAGES OF THE INVENTION

Page 5, please delete paragraph [0017].

Page 6, please replace paragraph [0028] with the following amended paragraph:

[0028] ~~Drawings~~

BRIEF DESCRIPTION OF THE DRAWINGS

Please replace paragraph [0029] with the following amended paragraph:

[0029] A number of exemplary embodiments of the present invention ~~will be~~ **are** explained in greater detail below, in conjunction with ~~three figures:~~ **the drawings, in which:**

Page 7, please add the following new paragraph after paragraph [0032]:

[0032.5] DESCRIPTION OF THE PREFERRED EMBODIMENTS

Please replace paragraph [0034] with the following amended paragraph:

[0034] Therefore, the permeability of the sound and possibly a change in the phase are initially determined as a function of the frequency for various [[DPF]] **filter** loads. During operation, the acoustic impedance is determined and compared to the previously established impedances. This determines the load state of the [[DPF]] **filter**. According to one regeneration strategy, a suitable regeneration procedure can be initiated, for example, when a certain fill state has been exceeded. The acoustic impedance can be determined in the vehicle in a number of ways.

Page 8, please delete paragraph [0035].

Please replace paragraph [0036] with the following amended paragraph:

[0036] In the embodiment form of the present invention depicted in Fig. 1, an acoustic source 1, also referred to as acoustic generator, is disposed in an exhaust pipe 10 upstream of the [[DPF]] filter 3 in the flow direction [[10]] 11 of the exhaust and an acoustic receiver 2 is disposed downstream of the [[DPF]] filter 3.

Page 9, please replace paragraph [0043] with the following amended paragraph:

[0043] By evaluating the impedance at different frequencies, it is possible to get a picture of the spatial distribution of particle deposits in the [[DPF]] filter 3. It is therefore fundamentally possible to distinguish between deposits disposed at the upstream or downstream end of the [[DPF]] filter 3.

Page 10, please replace paragraph [0047] with the following amended paragraph:

[0047] In general, the radial distribution of particles over the parallel channels 12 of the particle filter 3 is homogeneous. More detailed information about a potential inhomogeneous distribution in the radial direction can be obtained through the use of several acoustic generators and/or acoustic receivers. This allows for a channel-by-channel analysis of the [[DPF]] filter load if necessary.

Please delete paragraph [0048].

Please replace paragraph [0049] with the following amended paragraph:

[0049] In lieu of the above-described placement of the acoustic source 1 and acoustic receiver 2 on two different sides of the [[DPF]] filter 3 for transmission of the sound, the placement of the acoustic source 1 and acoustic receiver 2 on one side of the [[DPF]] filter can also generate

values for the reflection of the signal. Fig. 3 shows the corresponding placement. In it, the acoustic generator 1 and the acoustic receiver 2 are installed in the exhaust pipe 10 on the upstream side of the particle filter 3 in terms of the flow direction 11 of the exhaust. This placement in connection with pulsed signals corresponds to the operation of a sonar device.

Page 11, please delete paragraph [0051].

Please replace paragraph [0052] with the following amended paragraph:

[0052] Instead of using a speaker or a whistle as the acoustic source 1, another embodiment form, not shown in the drawings, uses the acoustic emission of an already existing source, in particular that of the engine. In this case, two acoustic receivers are advantageously used, one of which is disposed upstream of the [[DPF]] **filter** and the other of which is disposed downstream of it. The correlation between the incoming and outgoing acoustic signal makes it possible to in turn determine the acoustic transmission. The Fourier analysis yields the frequency-resolved impedance, which is particularly advantageous for the evaluation of the load state.

Please replace paragraph [0053] with the following amended paragraph:

[0053] If the engine noise is plotted in a time-resolved way and the values detected before and after the [[DPF]] **filter** are correlated with one another, then in addition to determining the damping, it is also possible to determine the signal travel time. The signal travel time can be analogously determined through pulse-like acoustic excitation with the aid of an acoustic generator and an acoustic receiver.

Please replace paragraph [0054] with the following amended paragraph:

[0054] If the spatial positions of the two acoustic receivers are known, then this makes it possible to determine the speed of sound based on the signal travel time. The same is true if the

spatial positions of the acoustic generator and the acoustic receiver are known. The speed of sound changes with the root of the absolute gas temperature, which is of interest, for example, for controlling the [[DPF]] filter regeneration. The shared use of the components according to the present invention makes it possible to eliminate a temperature sensor and test the functionality of other components, e.g. a preceding oxidizing converter provided to increase the temperature.

Page 12, please delete paragraph [0055].

Please replace paragraph [0057] with the following amended paragraph:

[0057] With the present invention, the internal state of the [[DPF]] filter is determined directly. The cross sensitivity to the volumetric flow that occurs during the differential pressure measurement is significantly reduced. The method and device permit inexpensive components to be used. The present invention can also be used to detect filter defects.

Please replace paragraph [0058] with the following amended paragraph:

[0058] The acoustic components for testing the [[DPF]] filter state can also simultaneously perform other monitoring functions for the exhaust train. The recorded spectrum of engine noise as a function of the operating state can be used to detect a defect in the exhaust train, e.g. a leak, or a defect in the engine. This is useful as a backup diagnostic procedure.

Please add the following new paragraph after paragraph [0058]:

[0059] The foregoing relates to a preferred exemplary embodiments of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, the latter being defined by the appended claims.